

REMARKS

Claims 1, 3-14 are pending. Claim 2 has been cancelled herein without prejudice or disclaimer. Claim 1 has been amended.

Reconsideration and allowance of the present application based the following remarks are respectfully requested.

Claim Rejection – 35 USC § 103

Claims 1-14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Gelernt (U.S. Patent No. 6,369,398) in view of Kleinschmidt (U.S. Patent No. 6,160,832) and further in view of Makinouchi (U.S. Patent No. 6,490,025). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 1 recites a lithographic projection apparatus comprising, *inter-alia*, “an acoustic sensor constructed and arranged to detect sounds caused by the passage of pulses of radiation of the projection beam; and a controller in communication with said acoustic sensor and responsive to an output signal of said acoustic sensor, wherein said controller is configured to control a radiation energy per unit area delivered by said projection beam of radiation to said substrate in response to said output signal of said acoustic sensor.”

Claim 13 recites an integrated circuit device manufacturing method comprising, *inter-alia*, “detecting one of: sounds caused by the passage of pulses of radiation of said projection beam; vibrations in an object on which said projection beam is incident, and sounds emitted by an object on which said projection beam is incident and controlling, responsive to the detecting, the radiation energy per unit area delivered by said projection beam to said substrate during an exposure of a target portion.”

By detecting sounds caused by the passage of pulses of radiation, a direct and in situ measurement of the projection beam intensity and/or changes of the projection beam intensity at, for example, the substrate level is determined. This allows, for example, to achieve accurate dose control of radiation reaching the substrate.

The Office Action concedes that Gelernt does not disclose, teach or suggest the use of an acoustic sensor to detect sounds caused by the passage of pulses of radiation of the projection beam.

Furthermore, Gelernt does not disclose, teach or suggest a controller in communication with an acoustic sensor and responsive to an output signal of the acoustic

sensor, the controller being configured to control a radiation energy per unit area delivered by a beam of radiation to a substrate in response to the output signal of the acoustic sensor. Gelernt does not provide a feedback to control the possible variation of intensity of the beam of radiation.

In response to Applicant's argument that there is no suggestion in either Gelernt or Kleinschmidt that the lithographic exposure system of Gelernt can be modified to use an acoustic detection device in accordance with Kleinschmidt, the Office Action directs the Applicant to a section in Gelernt reference which discusses selecting a lithographic wavelength so as to minimize intensity attenuation due to air absorption.

However, Gelernt is merely concerned about selecting a wavelength at which the absorption of ultraviolet radiation by molecular oxygen is minimized. According to Gelernt, if lithography is performed at an irradiating wavelength around the selected wavelength, the stringent requirement for high vacuum or inert gas purge system can be relaxed. Since the absorption spectrum of molecular oxygen is generally known to one of skill in the art, Gelernt selects a wavelength in the VUV range at which the absorption by molecular oxygen is at its minimum. Consequently, Gelernt does not need and would not benefit from an acoustic detection device to select a wavelength of ultraviolet radiation which corresponds to a minimum absorption of molecular oxygen. Therefore, Gelernt does not disclose or suggest anywhere using an acoustic detection device, such as a microphone, to find the minimum in VUV intensity absorption. Furthermore, Gelernt does not disclose or suggest anywhere measuring the intensity of the radiation beam and controlling the radiation energy per unit area delivered by the radiation beam to a substrate in response to an output signal from an acoustic sensor.

Kleinschmidt discloses a wavelength calibration system which is used for determining the absolute wavelength of an Excimer laser or a molecular fluorine laser. The wavelength calibration system of Kleinschmidt uses preferably a galvatron containing an element that photo-absorbs around the wavelength of the laser or a microphone for acoustic detection of the laser for wavelength calibration. Therefore, Kleinschmidt simply uses a microphone for wavelength calibration of a laser. Kleinschmidt does not disclose, teach or suggest anywhere using a microphone to detect sounds caused by the passage of a projection beam in conjunction with a controller in communication with the microphone and responsive to an output signal of the microphone to control a radiation energy per unit area delivered by the laser in response to the output signal of the microphone.

Consequently, neither Gelernt nor Kleinschmidt, alone or in combination, disclose, teach or suggest, *inter-alia*, “an acoustic sensor constructed and arranged to detect sounds caused by the passage of pulses of radiation of the projection beam; and a controller in communication with said acoustic sensor and responsive to an output signal of said acoustic sensor, wherein said controller is configured to control a radiation energy per unit area delivered by said projection beam of radiation to said substrate in response to said output signal of said acoustic sensor,” as recited in claim 1 and, *inter-alia*, “detecting one of: sounds caused by the passage of pulses of radiation of said projection beam; vibrations in an object on which said projection beam is incident, and sounds emitted by an object on which said projection beam is incident and controlling, responsive to the detecting, the radiation energy per unit area delivered by said projection beam to said substrate during an exposure of a target portion,” as recited in claim 13.

Claim 2 has been cancelled herein without prejudice or disclaimer. Therefore, the rejection of claim 2 under 35 U.S.C. § 103(a) is rendered moot.

With regard to claim 5, the Office Action concedes that Gelernt in view of Kleinschmidt does not disclose the use of a vibration sensor mechanically coupled to an object on which the projection beam is incident. Furthermore, as stated above with respect to claims 1 and 13, neither Gelernt nor Kleinschmidt, alone or in combination, disclose, teach or suggest “a controller in communication with said acoustic sensor and responsive to an output signal of said acoustic sensor, wherein said controller is configured to control a radiation energy per unit area delivered by said projection beam of radiation to said substrate in response to said output signal of said acoustic sensor,” as recited in claim 1 or “controlling, responsive to the detecting, the radiation energy per unit area delivered by said projection beam to said substrate during an exposure of a target portion,” as recited in claim 13.

Makinouchi does not overcome the deficiencies noted above in the combination of Gelernt and Kleinschmidt. Makinouchi merely discloses using a vibration sensor for detecting vibrations (accelerations) of a body due to movement of wafer and mask stages. Makinouchi does not disclose, teach or suggest “an acoustic sensor constructed and arranged to detect sounds caused by the passage of pulses of radiation of the projection beam.” Furthermore, Makinouchi does not disclose, teach or suggest “a controller in communication with said acoustic sensor and responsive to an output signal of said acoustic sensor, wherein said controller is configured to control a radiation energy per unit area delivered by said

projection beam of radiation to said substrate in response to said output signal of said acoustic sensor.”

In response to the arguments filed on December 22, 2003, the Office Action directs Applicant's to col. 5, line 29-35 in which Makinouchi uses an acceleration sensor (vibration sensor) and interpreted that the use of a vibration sensor in accordance with Makinouchi is equivalent to the use of a vibration sensor as recited in claim 5. Applicant respectfully disagrees.

The vibration sensor in Makinouchi is merely used to detect relatively high amplitude vibrations (accelerations) of a body due to movement of wafer and mask stages whereas the acoustic sensor as recited in claim 5 is adapted to detect sounds, i.e. low amplitude vibrations emitted by an object on which a beam of radiation is incident. Furthermore, the high amplitude vibrations (accelerations) in Makinouchi and the low amplitude sound vibration detected by the acoustic sensor of claim 5 lie in very different frequency ranges. Therefore, the vibration sensor of Makinouchi cannot be used to detect acoustic vibrations.

Consequently, for at least the above reasons, the Applicant respectfully submits that none of Gelernt, Kleinschmidt and Makinouchi, taken alone or in combination, disclose, teach or suggest the subject matter recited in claim 5.

Therefore, Applicant respectfully submits that claims 1 and 13, and claims 3-12 and 14, which are dependent from either claim 1 or claim 13, are patentable. Thus, Applicant respectfully requests that the rejection of claims 1-14 under § 103(a) be withdrawn.

CONCLUSION

In view of the foregoing, the claims are now in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, please contact the undersigned at the telephone number listed below.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

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